The Gm and Inv Allotypes in Kindreds of Kurdish Jews

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INTRODUCTION

The Gm allotypes of human IgG are transmitted in sets, much as are the antigens of of the Rh blood types. We shall refer to the sets as phenogroups. Other terms are "genetic system" and "haplotype." No assumption is made concerning the number of loci involved in determining the allotypes in a phenogroup. The phenogroups are distributed in different patterns (quantitative and qualitative) in the several races of man (reviewed in Steinberg 1969). The inter- and intraracial distributions of gamma globulin allotypes (Gm and Inv) have provided one of the most useful methods for comparing races with each other, and for comparing populations within races (reviewed in Steinberg 1969).

Jews have been dispersed over the world for many centuries. Genetic studies of these long-separated populations and of the peoples among whom they have lived could provide useful data concerning admixture, selection, and drift. The immigration to Israel of Jews from all over the world makes comparative studies of various Jewish populations relatively easy. An early study concerned a comparison of the finger-print patterns among Jewish and non-Jewish populations from different parts of Europe and from around the Mediterranean Sea (Sachs and Bat-Miriam 1957). The patterns of the Jewish populations were more similar to each other and to non-Jewish Mediterranean populations than to those of the populations among whom they had lived. More recent studies have been concerned with characters whose pattern of inheritance is better understood (see papers in Goldschmidt 1963 for details) and have shown greater variation among the Jewish populations studied. Although the gamma globulin allotypes (Gm and Inv) constitute one of the most powerful tools for comparing peoples, they have not been extensively used for study of populations in Israel (Ropartz et al. 1965). This paper is a report of one such study.

MATERIALS AND METHODS

The present sample includes 260 people in kindreds affiliated with the community of Kurdish Jews by origin or marriage and 21 unrelated Ashkenazic people. Members of three generations were available in most families. The hematological status of the Kurdish Jews

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was investigated in a thalassemia survey (Horowitz et al. 1966). Because of exhaustion of sera, 14 of 274 persons included in the thalassemia survey and four of the 25 Ashkenazic control subjects were not typed for Gm and Inv groups.

The geographic origin of the test subjects is summarized in table 1. About 80% belong to the community from the Kurdish mountains of northern Iraq; the remainder derive from the Urfa area of eastern Turkey and a few from other Jewish groups (Syria, Egypt, Baghdad, Morocco), having intermarried with Kurdish Jews.

The structure of the isolates from which the sample was drawn has been briefly described elsewhere (Goldschmidt and Cohen 1964). Since census data (Population and Housing Census, 1961) specify, at best, countries of origin instead of communities, we have only rough estimates of the present population sizes of these groups in Israel. These are 25,000–30,000 for the Kurdish Jews of northern Iraq and 2,000–3,000 for the group from eastern Turkey. Goldschmidt and Cohen (1964) stressed that the community from eastern Turkey is becoming completely integrated into an interethnic gene pool, and this is reflected in the data of the

TABLE 1

GEOGRAPHIC ORIGIN OF THE "ANCESTORS" OF THE KINDREDS*

No. of "Ancestors" Typed	Kurdish Jews		Other Non-Ashkenazic Jews	Ashkenazic Jews
	N. Iraq	E. Turkey		
Zygotes	55(1)†	16 (2)	5 (3)	21‡
Phenogroups	108§	30	.....	.....
Phenogroups inferred‖	14	11	.....	.....
Total no. of phenogroups.	122	41	.....	41

* "Ancestors" refers to individuals whose phenogroups were counted to estimate the phenogroup frequencies. See text for further explanation.

† The numbers in parentheses indicate individuals with only *one* parent derived from the indicated community (Kurdish Jews) or with parents from two different communities (other non-Ashkenazic Jews).

‡ Two members in this sample were sisters, hence 41 instead of 42 phenogroups.

§ One individual contributed only one phenogroup, not accounted for by her daughter, to the sample.

‖ Inferred for the phenogroup contributed to a child by an untested parent.

present sample which indicate that about half of the members (23/47) of the younger generations were born to intercommunity unions.

A third center of Kurdish Jewry is situated in northwestern Persia and its members are not represented in the present sample. In Israel they amount to at least 3,000–4,000, while a similar number has remained in Iran to this day (Magnarella 1969).

There is every reason to assume that the genetic isolation among these three groups was never complete. There was a considerable geographic distance but no barrier of faith or tradition. From interviews of the older generation we know that an occasional successful merchant may have brought a bride from a long distance.

Regarding the origins of these three communities, historians have to rely on legends and traditions, since written records date back no longer than 800 years. According to their own tradition and that of their gentile neighbors, the settlements of Jews in Kurdistan date back to the exile of Shomron in the eighth century B.C. The Old Testament (II Kings, 17: 1–7) reports the invasion of Shalmanezar, King of Assyria, into Samaria (Shomron), the capital of the Kingdom of Israel, and the deportation of many Israeli subjects to Assyria and Media (722–721 B.C.). Although the biblical text does not permit the accurate identification of the areas where these deportees became settled, it does not contradict the tradition of the Kurdish Jews who consider themselves as descended from the "10 lost tribes." About 150 years later these settlers were probably reinforced by deported subjects from the Kingdom of Judea after Nebuchadnezzar's conquest of Jerusalem in 586 B.C.

Until quite recently, many of the Kurdish Jews of northern Iraq spoke a dialect of Aramaic which they called "Targum." Aramaic was an official language of the Assyrian and Persian Empires, and Aramaic dialects survive also among a few sects of non-Jews of the area. It is, however, interesting that the dialect of the Kurdish Jews is called "Targum" (i.e., "translation"), since this is the name of the language used by the authors of the Talmud (third to fourth century A.D.) who lived in Baghdad in southern Mesopotamia.

The existence in Kurdistan of congregations adhering strictly to Jewish religious tradition is reported by various Jewish travelers. The earliest of these was Benjamin Metudela from Spain who found an active congregation of Jews in Amedyia of northern Iraq (A.D. 1170). He also reports an armed revolt of the Jews of this area, headed by David Elroi, which had taken place a few years before his visit. From the late twelfth century A.D. we have more or less continuous written evidence of the existence of Jewish congregations in Kurdistan.

The Kurdish mountain ranges extend from Urfa in southeastern Turkey, eastward to Miyandub in Persia, and southward to Mosul and Erbil in northern Iraq. For centuries, the larger part of this area was a province of the Ottoman Empire, and there was thus no political barrier separating the various settlements of Kurdish Jews. It was only after World War I that the region became divided between three different states and the central part where the majority of Kurdish Jews resided was alloted to Iraq.

The Jewish communities in the Kurdish areas of northern Iraq were scattered over many towns (including Zakho, Mosul, and Erbil) and villages (such as Amedyia, Dahok, Bitanura) in most of which they constituted a minority, whereas at least one of these villages (Sandor) was settled exclusively by Jews practicing agriculture (Ben-Jacob 1961). The Kurdish Jews of Turkey were also small minorities in several towns and settlements, the most important of which were Urfa, Diyarbakir, Siverek, and Cermik.

Regarding the degree of isolation of these people from their gentile neighbors, we know as little as with respect to most other Jewish communities in the Diaspora. All marriage outside the faith was strictly prohibited. By the patient accumulation of data on polymorphic traits, we may, in the future, obtain some rough estimate of the amount of gene flow that passed the barrier of tradition.

Gm and Inv Typing

The determination of the Gm groups and of Inv (1) was performed at Case Western Reserve University. Most of the typing was done on serum; in a few cases plasma from blood taken with EDTA was used. All samples were tested for Gm (1, 2, 3, 5, 6, 13, 14) and Inv (1). Selected samples were also tested for one or more of the following: Gm (15), Gm (17), Gm (21), Gm (24), and Inv (3). The reagents employed are listed in table 2. Typing was done by methods previously described (Steinberg 1962).

RESULTS

The detailed data for the 24 kindreds with phenogroups usually present only in Caucasoids and for the 13 kindreds with one or more members with phenogroups not usually present in Caucasoids have been deposited in a documentation archives and are available on request.* The latter phenogroups are $Gm^{1,5,6,14}$ (two kindreds), $Gm^{1,5,6,24}$ (four kindreds), $Gm^{1,5,13,14}$ (seven kindreds), and $Gm^{1,13}$ (two kindreds). Two of the kindreds each had individuals with two of the phenogroups, hence the total of 15 rather than 13. Thirty-four individuals were tested for Inv (3) in addition to Inv (1) and all of these were positive, including two who were also positive for Inv (1).

The phenogroup frequencies among the families may be estimated by a direct gene

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count, because the extensive Gm typing and the family structure removed any ambiguity concerning the genotypes of the tested individuals. The estimates are based on the genotypes of the individuals who account for the phenogroups in a family. Ambiguity was present in the inferred phenogroups of only three untested parents, and these were not included in the totals. The results of the count are presented in table 3, as are also the Inv^1 allele frequencies.

There are two sisters [one Gm (1, 3, 5, 13, 14, 21) and one Gm (3, 5, 13, 14)] among the 21 Ashkenazic individuals tested (table 4); hence these 21 individuals represent

TABLE 2

LIST OF REAGENTS USED TO DETERMINE THE ALLOTYPES

Allotype	Anti-Allotype		Anti-D	
	Origin	Dilution	Origin	Dilution
Gm (1)	Wee	1/32	251	1/3
	Wils	1/4		
(2)	Tay	1/16	Ham	1/3
	Tyl	1/32		
(3)	Wri	1/4	Kin	9/10
	Ewe	1/4	Jac	1/3
	Joh	1/4	3196	1/3
(5)	Dra	1/8	21369	1/32
	Ben	1/8	3419	1/5
(6)	Deb	1/4	War	1/3
	Eil	1/4		
(13)	Tho	1/4	21369	1/32
	Hou	1/4	3419	1/5
(14)	Bur	1/16	3419	1/5
(15)	2624	1/16	Vai	1/3
(17)	Anti-17	1/8	251	1/3
(21)	Monkey E	1/32	Ham	1/3
	F	1/32		
(24)	2504	1/16	War	1/3
Inv (1)	Mat	1/4	Roe	1/3
(3)	Nee	1/4	Ham	1/3

SOURCE.—The nomenclature is that suggested by the *WHO* (1965).

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41 independent genomes rather than 42. Analysis of the above data shows that the 41 independent Gm phenogroups are distributed as follows: 31 are $Gm^{3,5,13,14}$, eight $Gm^{1,21}$, one $Gm^{1,2,21}$ [probably $Gm^{1,17,21}$ and $Gm^{1,2,17,21}$, respectively, but Gm (17) was not determined], and one $Gm^{1,13,15,17}$ (i.e., 76%, 20%, 2%, and 2%, respectively). Two of the 41 (5%) *Inv* alleles represented by the sample determined Inv (1) [assuming that both Inv (1) individuals are heterozygotes].

The Inv^1 frequencies in all three samples are relatively low as compared with northern European populations (Inv^1 is about 10% in most northern European populations), but not for southern European or Mediterranean populations. The absence of Inv (1) from the sample from eastern Turkey could be due to chance. The Gm data are of greater interest.

The absence of the $Gm^{1,2,17,21}$ phenogroups from both of the Jewish samples of

Kurdistan may be due to sampling variation. Similarly, the absence of the $Gm^{1,5,6}$ and $Gm^{1,13,15}$ phenogroups from the sample of eastern Turkey may be due to chance. Although the survey of 1966 (Horowitz et al. 1966) has furnished some hints of other genetic differences between the groups from Iraq and from Turkey, in particular in regard to the lower concentration of the B− variant of G6PD in the population of eastern Turkey, we do not feel entitled to attribute too much importance to the observed differences in the representation of the different *Gm* phenogroups in view of the small sample sizes and the large variances of the frequency estimates. It is more pertinent to consider the meaning of the presence in these populations of phenogroups $Gm^{1,5,6,24}$, $Gm^{1,5,6,14}$, $Gm^{1,5,13,14}$ (common among Negroids), and $Gm^{1,13,15}$ (common among Mongoloids, African Bushmen, and Ainu).

The $Gm^{1,13,15}$ phenogroup was present also in one of the 21 Ashkenazic donors, and one of us (AGS) has previously unpublished data for an Ashkenazic family from

TABLE 3

GM PHENOGROUPS AND INV (1) ALLELE FREQUENCIES AMONG THE INDIVIDUALS WHO ACCOUNT FOR THE GENOMES IN KINDREDS IN SAMPLES OF KURDISH JEWS (SEE TEXT FOR FURTHER EXPLANATION)

COMMUNITY	NO. OF PHENO-GROUPS	GM PHENOGROUPS*										Inv^1	
		3, 5, 13, 14		1, 21		1, 5, 6†		1, 5, 13, 14		1, 13‡		No.	%§
		No.	%	No.	%	No.	%	No.	%	No.	%		
Northern Iraq.....	122	99	81.1	9	7.4	7	5.7	4	3.3	3	2.5	5	4.1
Eastern Turkey.....	41	29	71	10	24	0	.....	2	5	0	.....	0	.....

* The generic term Gm is omitted. All samples were tested for Gm (1, 2, 3, 5, 6, 13, 14, 21). All phenogroups except $Gm^{3,5,13,14}$ have Gm (17), but only a few samples were tested for Gm (17), usually because of a shortage of reagents.

† Five samples were Gm (−14, 24), one was Gm (14, −24), and one (father's father kindred 905) was incompletely tested, because of a paucity of serum.

‡ Gm (15) is usually associated with this phenogroup.

§ On the assumption that all Inv (1) individuals are heterozygotes. Only two were tested for Inv (3) and both were positive.

TABLE 4

GM AND INV PHENOTYPES OF 21 ASHKENAZIC JEWS

NO.	GM		INV (1) POSITIVE
	Phenotype	Probable Genotype	
12.....	3, 5, 13, 14	3, 5, 13, 14/3, 5, 13, 14	1
6.....	1, 3, 5, 13, 14, 21	3, 5, 13, 14/1, 21	1
1.....	1, 3, 5, 13, 14, 15, 17	3, 5, 13, 14/1, 13, 15, 17	0
1.....	1, 2, 3, 5, 13, 14, 21	1, 2, 21/3, 5, 13, 14	0
1.....	1, 21	1, 21/1, 21	0

NOTE.—All were tested for Gm (1, 2, 3, 5, 6, 13, 14, and 21), but only one, as indicated, was tested for Gm (17).

Poland, now resident in Mexico, in which both parents carried the $Gm^{1,13,15}$ phenogroup. The data for this family are presented in table 5. It is possible that the $Gm^{1,13,15}$ phenogroup is common among Jews and perhaps other peoples from around the Mediterranean Sea. Unfortunately, tests with Gm (13) and Gm (15) have not been done on samples from these regions.

The $Gm^{1,5,6,24}$, $Gm^{1,5,6,14}$, and $Gm^{1,5,13,14}$ phenogroups are common among Africans and are reported to be absent or very rare among populations that are supposedly free of Negroid admixture. It should, however, be noted that comparatively few populations and even fewer family samples from the region surrounding the Mediterranean Sea have been studied with an adequate battery of sera. Mourant (1954) discussed the comparatively high frequency of the so-called African chromosome among the Rhesus phenogroups, that is, the *cDe* (the R^o chromosome) among Jews and gentiles of the Middle East. He suggested that the high concentration of this African marker chromosome indicates a closer affinity between African and Middle East peoples than is demonstrated by the distribution of the morphological

TABLE 5

GM PHENOTYPES OF AN ASHKENAZIC FAMILY

Family Member	Gm Phenotype	Probable Genotype
Father.....	1, 3, 5, 13, 14, 15	1, 13, 15/3, 5, 13, 14
Mother....	1, 3, 5, 13, 14, 15	1, 13, 15/3, 5, 13, 14
Child 1.....	1, 3, 5, 13, 14, 15	1, 13, 15/3, 5, 13, 14
Child 2.....	1, 13, 15	1, 13, 15/1, 13, 15

NOTE.—Tests were done for Gm (1, 2, 3, 5, 6, 13, 14, 15, 21).

African characteristics, such as skin color, shape of lips, and curliness of hair. The present findings lend support to this assumption.

The Gm (6) antigen has been demonstrated in Caucasoid families but it appears to be transmitted by $Gm^{3,5,6,24}$ and $Gm^{3,5,6,14}$ phenogroups (van Loghem and Martensson 1967). Gm (6) has been found in about 1% (15/1729) of a sample of unrelated Dutch individuals (van Loghem and Martensson 1967). Eight clearly had the $Gm^{3,5,6,24}$ or $Gm^{3,5,6,14}$ phenogroup. Gm (6) must be rare in Caucasoid populations other than the Dutch, because it has not been found in tests of over 2,000 samples of other northern Europeans tested for Gm (1), Gm (2), Gm (5), and Gm (6), as a minimum (a summary of the published data is in preparation). The two phenogroups transmitting Gm (6) in the Kurdish Jews are clearly those common in Negroids, namely, $Gm^{1,5,6,24}$ and $Gm^{1,5,6,14}$, and not those found in the Dutch population.

The presence of the $Gm^{1,5,13,14}$ phenogroup in the samples from the Kurdish Jews raises the question of whether this phenogroup is present among Caucasoids of unmixed ancestry. Several samples, comprising among them more than 5,000 Europeans, have been tested for at least Gm (1), Gm (2), and Gm (5) simultaneously, and in all cases only the assumption of the common Caucasoid phenogroups Gm^1, $Gm^{1,2}$, and Gm^5 was required to explain the data (unpublished summary of the literature). However, Ruffie et al. (1964), Ropartz et al. (1965), Bajatzadeh and Walter (1968), and

Fraser et al. (1969) have reported samples from Caucasoids that were tested for the Gm (1), Gm (2), and Gm (5) and that appear to require a $Gm^{1,5}$ phenogroup in addition to the common phenogroups Gm^1, $Gm^{1,2}$, and Gm^5 to explain the observed distributions.

Ropartz et al. (1965) reviewed the data from 45 population samples tested for Gm (1), Gm (2), and Gm (5). In seven of the samples the assumption of three phenogroups (Gm^1, $Gm^{1,2}$, Gm^5) gave poor agreement between the frequencies expected on the basis of the Hardy-Weinberg distribution and the observed frequencies. The assumption of four phenogroups ($Gm^{1,5}$ plus the other three) also gave poor agreement between the observed and expected values for five of the seven. There was good agreement between the observed and expected frequencies on the assumption of four phenogroups for the remaining two samples. One sample was composed of the parents of 386 German families reported by Ritter et al. (1964), and the second was composed of samples from Moroccan Jews (population 37 in Ropartz et al. 1965). Examination of the offspring from the German families in which at least one parent was Gm (1, 5) [Gm (2) was ignored for this analysis] shows 262 Gm (1, 5) offspring versus 247 Gm (1) plus Gm (5) offspring among a total of 509 offspring. The expected numbers are 254.5 of each ($\chi^2_{(1)} = 0.442$, $.60 > P > .50$). The family data do not indicate a significant excess of Gm (1, 5) offspring, as would be expected if a $Gm^{1,5}$ phenogroup were common in this population. A possible explanation for the discrepancy between the segregation data and parental data is that an effort had been made to select segregating families for analysis. This would result in an excess of parents with Gm (1, 5) in their allotypes. The data from the sample of Moroccan Jews may be explained by African admixture, but these data require confirmation by the study of kindreds. If there are, indeed, a series of Mediterranean Jewish populations among whom Negroid *Gm* phenogroups are segregating, it should be stressed that these same populations have shown no evidence of the presence of other characteristically African genes. Thus, to date, there is no single report of a Jewish population or family possessing the Hb S (sickle hemoglobin) gene.

Ruffie et al. (1964) studied five populations from France and Switzerland. Good agreement between the observed and expected numbers for the several phenotypes was obtained for four of the populations on the assumption of three phenogroups; the fifth required four phenogroups. Two of the five samples came from populations in Rousillon (located in the southeast of France, along the Mediterranean coast), one from the plains, and one from the mountains. Interestingly, the one from the plains is well explained on the assumption of three phenogroups ($P > .90$) while the one from the mountains requires the assumption of four.

Bajatzadeh and Walter (1968) studied six population samples gathered from different regions of Iran. Five of them are adequately described by the assumption of three phenogroups; the sixth, from Teheran, requires the assumption of four phenogroups. The authors divided the Teheran sample into two groups based on age (those born before 1936 versus those born after 1935). The sample composed of the 92 older individuals was adequately explained on the assumption of three phenogroups ($P > .30$), while the sample composed of the 187 younger individuals re-

quired the assumption of four phenogroups. This interesting observation remains unexplained.

Fraser et al. (1969) tested serum samples from individuals in two Greek villages for Gm (1), Gm (2), Gm (5), and Gm (6). The $Gm^{1,5,6}$ phenogroup was found in both villages at a frequency of about 1%. The $Gm^{1,5}$ phenogroup was found in one of the villages (no. 2) at a frequency of about 14%, but not in the other. The presence of these phenogroups was confirmed by family studies. Hemoglobin S, which is prevalent in Negroids from some regions of Africa but not in Caucasoids, was prevalent in both villages (Fraser et al. 1964, 1969).

The conclusion that the phenogroups common to Negroids are found only in Caucasoid populations living in North Africa or along the coast of the Mediterranean Sea seems inescapable. The presence of the $Gm^{1,5,6,24}$, $Gm^{1,5,6,14}$, and $Gm^{1,5,13,14}$ phenogroups among the Kurdish Jews, therefore, suggests African admixture, and their frequency indicates that this admixture may be as high as 9%. Again, it should be stressed that other African marker genes, such as the sickle hemoglobin gene, are completely absent in this population (Goldschmidt et al. 1968). The low frequency of the Inv^1 allele among the Kurdish Jews would also appear to contradict the assumption of Negroid admixture because Inv^1 is more frequent in Negroids than in Caucasoids.

Hitherto, the Kurdish Jews had been known to possess uniquely high frequencies of the B variant at the G6PD locus (Horowitz et al. 1966). The present study has produced evidence of an additional polymorphism, namely, the Gm types, in which the Kurdish Jews differ from all other Jewish and gentile populations studied until now.

We have no historic evidence for a temporary drastic reduction in the size of the ancestral Jewish population in Kurdistan such as could account for dramatic drift at all polymorphic loci. The present data invite speculation on the occurrence of drift during the early history of the Kurdish Jews before their differentiation into the three subgroups. The populations from eastern Turkey and from northern Iraq share certain features which set them apart from all other ethnic groups studied so far: their B (−) concentrations of G6PD (Horowitz et al. 1966) exceed the highest recorded in Sardinia (Siniscalco et al. 1966); their Inv (1) frequencies are lower than recorded elswhere; and the $Gm^{1,2}$ phenogroup is absent or extremely rare in both populations from Kurdistan.

Alternatively to the speculations on drift, the genetic differentiation of the Kurdish Jews at these three loci could be explained by rapid evolution owing to the susceptibility of these loci to selection pressures. While many authors have attempted to define the opposed selective forces acting on the G6PD locus, the adaptive significance of the gamma globulin loci appears to be quite unknown (Steinberg 1969). Nevertheless, it is possible that in the future the gamma globulin allotype will be classified among those that exhibit rapid response to selective forces.

SUMMARY

The Gm and Inv types were determined in a sample of 37 kindreds of Kurdish Jews. The majority of the subjects originated from Kurdistan of northern Iraq. The re-

mainder derived from the Urfa area of eastern Turkey. Members of three generations were tested in most of the kindreds. The phenotypes of all tested family members were used for the accurate definition of the genotypes of the oldest generation whose phenogroups were used for frequency estimates.

No chromosome with Gm (2) information was detected in these two samples. The $Gm^{1,13}$ phenogroup (not usually present in Caucasoids) was detected in both communities, in one of 21 unrelated Ashkenazic Jews, and in an Ashkenazic family. It is possible that this phenogroup is common among Jews.

The phenogroups $Gm^{1,5,6,24}$, $Gm^{1,5,6,14}$, and $Gm^{1,5,13,14}$, common in Negroids, were found with a combined frequency of about 9% among the sample from northern Iraq. The only phenogroup not common in Caucasoids that was observed among the 41 phenogroups from the Urfa area of Turkey was $Gm^{1,5,13,14}$. The sample sizes are too small to permit firm conclusions to be drawn from comparisons of the two populations.

Inv (1) positive subjects were absent in the small sample from eastern Turkey. In the community of northern Iraq, this phenotype was rarer than in any other population recorded in the literature.

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New Citation Style

Beginning with the January 1971 issue, the *American Journal of Human Genetics* will conform to the uniform style on bibliographic citations agreed upon by many biomedical journals. This will involve the following changes:

1. Cite references in text by number: "The models for interactions presented here and those previously presented [3, 4] are rather rigorous in specifications."

2. Arrange bibliography in the numerical order that references were cited in text; doublespace throughout without indenting.

3. Arrange data for each reference as follows:

Single Author

RENWICK JH: Progress in mapping human autosomes. *Brit Med Bull* 25: 65–73, 1969

Two and Three Authors

YING KL, IVES E: . . . .

SINGAL DP, MICKEY MR, TERASAKI PI: . . . .

Four or More Authors

RAPLEY S, ROBSON EB, HARRIS H, et al: . . . .

Books

RACE RR, SANGER R: *Blood Groups in Man*, 5th ed. Philadelphia, Davis, 1968

BODMER W, BODMER J, IHDE D, et al: Genetic and serological association analysis of the HL-A leukocyte system, in *Computer Applications in Genetics*, edited by MORTON NE, Honolulu, University of Hawaii Press, 1969, pp 117–127